

Gastrointestinal Helminths of the Western Brush Lizard, *Urosaurus graciosus graciosus* (Phrynosomatidae)

Stephen R. Goldberg,¹ Charles R. Bursey,² and Rana Tawil¹

¹Department of Biology, Whittier College, Whittier, California 90608

²Department of Biology, Pennsylvania State University, Shenango Valley Campus,
147 Shenango Avenue, Sharon, Pennsylvania 16146

Abstract.—Forty-one *Urosaurus graciosus graciosus* Hallowell, 1854, from Nevada and California were examined for helminths. Two lizards (5% prevalence) were infected with helminths. One female harbored one *Oochoristica* sp. and another female harbored one third stage *Physaloptera* sp. *Physaloptera* sp. is a new host record and is the first nematode recorded from *Urosaurus graciosus*. Helminth fauna of *U. graciosus* is compared to that of 22 lizard species from Riverside County, California.

The brush lizard, *Urosaurus graciosus* Hallowell, 1854, is a desert species which ranges from southern Nevada and western Arizona to northwest Sonora and northeast Baja California where it inhabits areas of loose sand and scattered brush, especially creosote bushes (Stebbins 1985). Two subspecies are recognized: the western brush lizard, *Urosaurus graciosus graciosus* Hallowell, 1854, and Arizona brush lizard, *Urosaurus graciosus shannoni* Lowe, 1955. To our knowledge there is but one previous report of helminths from *Urosaurus graciosus*. Telford (1970) reported a prevalence of 6% for the cestode, *Oochoristica scelopori* Voge and Fox, 1950. The purpose of this paper is to report the helminths of *Urosaurus graciosus graciosus* and compare them to helminth faunas found in 22 species of sympatric lizards.

Methods

Forty-one adult (29 female, 12 male) *U. graciosus graciosus*, mean snout–vent length (SVL) = 48.6 mm $\pm$ 4.0 S.D. (range 38–55 mm), were examined. Twenty were collected at Boulder City (35°59'N, 114°50'W) 747 m elevation, Clark County, Nevada during August 1935. Fifteen were collected at Palm Springs (33°49'N, 116°32'W) 142 m elevation, Riverside County, California in May 1970; three at Cadiz Lake (34°17'N, 115°23'W), 50 m elevation, San Bernadino, California in July 1972; one at Blythe (33°32'N, 114°35'W) 82 m elevation, San Bernadino County, California in April 1973, and two at Thousand Palms (33°49'N, 116°23'W) 61 m elevation, Riverside County, California in March 1971 (for Accession numbers see Appendix 1).

The specimens had been preserved in 10% formalin and were later stored in 70% ethyl alcohol. The body cavity was opened by a longitudinal incision from vent to throat. Gastrointestinal tract, liver, and body cavity were examined for helminths. Each helminth was identified using a glycerol wet mount. The cestode was stained with Delafield's hematoxylin utilizing the standard regressive staining technique and mounted in Canada balsam for study as a whole mount.

Table 1. Helminths of lizards from Riverside County, California.

Lizard family and species	Helminth	Prevalence	Reference
Anguidae			
<i>Elgaria multicarinata webbii</i>	<i>Physaloptera retusa</i> <i>Baerietta gerhonioti</i> <i>Mesocostoides</i> sp.	13% (4/30) 63% (19/30) 7% (2/30)	Telford 1970 Telford 1970 Telford 1970
Crotaphytidae			
<i>Gambelia wislizenii</i>	<i>Atractis penneri</i> <i>Physaloptera retusa</i> <i>Thubunaea iguanae</i> <i>Oochoristica scelopori</i>	75% (3/4) 40% (2/5) 20% (1/5) 40% (2/5)	Telford 1970 Telford 1970 Telford 1970 Telford 1970
Gekkonidae			
<i>Coleonyx variegatus</i>	<i>Spauligodon californiensis</i> <i>Thubunaea iguanae</i>	56% (10/18) 11% (2/18)	Telford 1970 Telford 1970
Phrynosomatidae			
<i>Callisaurus draconoides</i>	<i>Atractis penneri</i> <i>Physaloptera retusa</i> <i>Spauligodon giganticus</i> <i>Thubunaea iguanae</i> <i>Mesocostoides</i> sp. <i>Alaearis yumanae yumanae</i> <i>Atractis scelopori</i>	33% (2/6) 26% (5/19) 21% (4/19) 5% (1/19) 5% (1/19) 100% (1/1) 90% (19/21)	Gambino and Heyneman 1960 Telford 1970 Telford 1970 Telford 1970 Telford 1970 Telford 1970 Telford 1970
<i>Dipsosaurus dorsalis dorsalis</i>	<i>Alaearis yumanae yumanae</i> <i>Atractis scelopori</i>	27% (4/15) 95% (20/21) 100% (2/2)	Gambino and Heyneman 1960 Telford 1970 Telford 1970
<i>Phrynosoma coronatum blainvillii</i>	<i>Atractis penneri</i> <i>Skrjabinoptera phrynosoma</i> <i>Atractis penneri</i> <i>Skrjabinoptera phrynosoma</i> <i>Atractis penneri</i> <i>Skrjabinoptera phrynosoma</i>	33% (1/3) 20% (1/5) 100% (2/2) 100% (1/1) 67% (2/3)	Telford 1970 Gambino and Heyneman 1960 Telford 1970 Telford 1970 Telford 1970 Telford 1970
<i>P. mcallii</i>			
<i>P. platyrhinos calidiarum</i>			

Table 1. Continued.

Lizard family and species	Helminth	Prevalence	Reference
<i>Sauromalus obesus obesus</i>	<i>Alaeuris priapus</i>	25% (3/12)	Telford 1970
	<i>Alaeuris sauromali</i>	100% (12/12)	Telford 1970
	<i>Alaeuris yumanae brevispicula</i>	17% (2/12)	Telford 1970
	<i>Atractis scelopori</i>	50% (1/2)	Gambino and Heyneman 1960
<i>Sceloporus graciosus vandenburgianus</i>		100% (12/12)	Telford 1970
	<i>Macdonaldius</i> sp.	8% (1/12)	Telford 1970
	<i>Spauligodon giganticus</i>	34% (24/71)	Telford 1970
	<i>Mesocestoides</i> sp.	1% (1/71)	Telford 1970
<i>S. magister magister</i>	<i>Ochoeristica scelopori</i>	10% (7/71)	Telford 1970
	<i>Atractis penneri</i>	50% (26/52)	Telford 1970
	<i>Thubunaea iguanae</i>	23% (12/52)	Telford 1970
	<i>Atractis penneri</i>	6% (7/116)	Telford 1970
<i>S. occidentalis biseriatus</i>	<i>Parapharyngodon iguanae</i>	1% (1/116)	Telford 1970
	<i>Physaloptera retusa</i>	13% (15/116)	Telford 1970
	<i>Spauligodon giganticus</i>	21% (24/116)	Telford 1970
	<i>Mesocestoides</i> sp.	1% (1/116)	Telford 1970
<i>S. orcutti orcutti</i>	<i>Ochoeristica scelopori</i>	23% (27/116)	Telford 1970
	<i>Atractis penneri</i>	17% (4/23)	Telford 1970
	<i>Parapharyngodon iguanae</i>	13% (3/23)	Telford 1970
	<i>Physaloptera retusa</i>	48% (11/23)	Telford 1970
<i>Petrosaurus mearnsi</i>	<i>Spauligodon giganticus</i>	13% (3/23)	Telford 1970
		4% (3/74)	Goldberg and Bursey 1991b
	<i>Thubunaea iguanae</i>	13% (3/23)	Telford 1970
	<i>Ochoeristica scelopori</i>	22% (16/74)	Goldberg and Bursey 1991b
<i>Uma notata</i>	<i>Parapharyngodon iguanae</i>	8% (2/24)	Telford 1970
	<i>Spauligodon mearnsi</i>	(?/2)	Egerly 1952
	<i>Strongyluris riversidensis</i>	63% (15/24)	Telford 1970
		(?/2)	Egerly 1952
<i>Uma notata</i>	<i>Atractis penneri</i>	50% (12/24)	Telford 1970
	<i>Skrjabinoptera phrynosoma</i>	27% (4/15)	Telford 1970
		53% (8/15)	Telford 1970

Table 1. Continued.

Lizard family and species	Helminth	Prevalence	Reference
<i>Urosaurus</i> <i>graciosus</i> <i>graciosus</i>	<i>Mesocostoides</i> sp.	20% (2/10)	Mankau and Widmer 1977
	<i>Oochoristica</i> <i>scelopori</i>	7% (1/15)	Telford 1970
	<i>Atractis</i> <i>penneri</i>	100% (2/2)	Gambino and Heyneman 1960
	<i>Physaloptera</i> sp.	2% (1/41)	This study
	<i>Oochoristica</i> <i>scelopori</i>	6% (2/34)	Telford 1970
<i>Uta</i> <i>stansburiana</i> <i>stefnegeri</i>	<i>Oochoristica</i> sp.	2% (1/41)	This study
	<i>Atractis</i> <i>penneri</i>	8% (51/639)	Telford 1970
	<i>Parapharyngodon</i> <i>iguanae</i>	1% (6/639)	Telford 1970
	<i>Physaloptera</i> <i>retusa</i>	3% (19/639)	Telford 1970
	<i>Thubunaea</i> <i>iguanae</i>	6% (38/639)	Telford 1970
	<i>Mesocostoides</i> sp.	14% (89/639)	Telford 1970
		5% (1/19)	Mankau and Widmer 1977
Scincidae			
<i>Eumeces</i> <i>gilberti</i> <i>rubricaudatus</i>	<i>Acanthocephala</i> larva	17% (1/6)	Telford 1970
<i>Eumeces</i> <i>skiltonianus</i>	<i>Physaloptera</i> <i>retusa</i>	7% (1/14)	Telford 1970
Teiidae	<i>Mesocostoides</i> sp.	7% (1/14)	Telford 1970
	<i>Pharyngodon</i> <i>cuemidophori</i>	31% (15/49)	Telford 1970
	<i>Skrjabinoptera</i> <i>phrynosoma</i>	2% (1/49)	Telford 1970
	<i>Thubunaea</i> <i>iguanae</i>	10% (5/49)	Telford 1970
	<i>Oochoristica</i> <i>bivittellobata</i>	27% (13/49)	Telford 1970
Xantusiidae			
<i>Xantusia</i> <i>henshawi</i>	<i>Thubunaea</i> <i>iguanae</i>	4% (2/51)	Telford 1970
<i>X. vigilis</i> <i>vigilis</i>	<i>Parapharyngodon</i> <i>californiensis</i>	40% (17/43)	Anreim 1951
		12% (6/51)	Telford 1970
	<i>Oochoristica</i> <i>scelopori</i>	21% (9/43)	Anreim 1951
		22% (11/51)	Telford 1970
	<i>Parapharyngodon</i> <i>californiensis</i>	22% (4/18)	Telford 1970
	<i>Oochoristica</i> <i>scelopori</i>	6% (1/18)	Telford 1970

Table 2. Amphibians and reptiles harboring third stage larvae of *Physaloptera* sp. (adults absent).

Host	Locality	Prevalence	Reference
Amphibia			
<i>Ambystoma opacum</i>	North Carolina	5% (1/21)	Mann 1932
<i>Desmognathus fuscus</i>	North Carolina	10% (4/41)	Mann 1932
	North Carolina	not given	Walton 1935
	North Carolina	2% (3/147)	Rankin 1937
	Georgia	not given	Reiber et al. 1940
<i>Plethodon glutinosus</i>	North Carolina	10% (4/39)	Mann 1932
	North Carolina	not given	Walton 1935
	Georgia	not given	Reiber et al. 1940
<i>Pseudorhombus montanus</i>	North Carolina	33% (1/3)	Rankin 1937
<i>Acris crepitans</i>	Oklahoma	not given	Morgan 1941
	Ohio	10% (3/30)	Ashton and Rabalais 1978
<i>Hyla arenicolor</i>	Utah	41% (14/34)	Parry and Grundmann 1965
<i>H. versicolor</i>	Virginia	11% (3/28)	Campbell 1968
<i>Pseudacris brimleyi</i>	North Carolina	4% (2/55)	Brandt 1936
<i>P. crucifer</i>	North Carolina	3% (2/60)	Brandt 1936
	Oklahoma	not given	Morgan 1941
<i>Rana catesbeiana</i>	Oklahoma	not given	Morgan 1941
	North Carolina	20% (14/71)	Brandt 1936
	Ohio	8% (2/24)	Ashton and Rabalais 1978
	Virginia	7% (2/30)	Campbell 1968
<i>R. clamitans</i>	Virginia	17% (5/29)	Campbell 1968
<i>R. pipiens</i>	Utah	17% (5/29)	Parry and Grundmann 1965
	Wisconsin	not given	Morgan 1941
	Oklahoma	not given	Morgan 1941
	Ohio	33% (2/6)	Ashton and Rabalais 1978
<i>R. utricularia</i>	Oklahoma	not given	Morgan 1941
<i>Bufo alvarius</i>	Arizona	38% (36/95)	Goldberg and Bursey 1991a
<i>B. americanus</i>	Ohio	6% (2/34)	Ashton and Rabalais 1978
<i>B. cognatus</i>	Arizona	14% (3/21)	Goldberg and Bursey 1991a
	Oklahoma	not given	Morgan 1941
<i>B. speciosus</i>	Oklahoma	not given	Morgan 1941

Table 2. Continued.

Host	Locality	Prevalence	Reference
<i>B. houstonensis</i>	Texas	6% (1/17)	Thomas et al. 1984
<i>B. microscaphus</i>	Utah	13% (5/38)	Parry and Grundmann 1965
<i>B. woodhousii</i>	Utah	17% (1/6)	Parry and Grundmann 1965
	Oklahoma	not given	Morgan 1941
<i>B. woodhousii fowleri</i>	North Carolina	2% (1/61)	Brandt 1936
	Virginia	28% (8/29)	Campbell 1968
<i>Scaphiopus holbrookii</i>	North Carolina	3% (2/60)	Brandt 1936
Reptilia			
<i>Cnemidophorus dixonii</i>	Texas	19% (11/58)	McAllister et al. 1991
<i>C. exsanguis</i>	New Mexico, Texas	38% (9/24)	McAllister 1990c
<i>C. gularis</i>	New Mexico, Oklahoma, Texas	10% (29/289)	McAllister 1990d
<i>C. inornatus arizonae</i>	Arizona	1% (1/78)	Goldberg and Bursey 1990a
<i>C. laredoensis</i>	Texas	3% (1/34)	McAllister et al. 1986
<i>C. neomexicanus</i>	New Mexico, Texas	3% (2/61)	McAllister 1990b
<i>C. sexlineatus</i>	South Dakota	30% (7/23)	Dyer 1971
<i>C. tessellatus</i>	Texas	19% (5/27)	McAllister 1990a
<i>C. tigris</i>	Nevada	1% (1/97)	Babero and Mathias 1967
<i>Elgaria multicarinata webbii</i>	California	1% (1/96)	Goldberg and Bursey 1990b
<i>Heloderma horridum</i>	not given	not given	Morgan 1941
<i>Holbrookia maculata</i>	Arizona	7% (1/15)	Goldberg and Bursey 1992b
<i>approximans</i>	Arizona	3% (1/38)	Goldberg and Bursey 1992a
<i>Sceloporus scalaris stevini</i>	California, Nevada	2% (1/41)	this study
<i>Urosaurus graciosus graciosus</i>	Arizona, New Mexico	4% (8/205)	Goldberg et al. 1993
<i>U. ornatus</i>			

Results

One cestode, *Oochoristica* sp. was removed from the small intestine of a single female lizard, SVL = 47 mm (LACM 139654) and one nematode, a third stage *Physaloptera* sp. was recovered from the stomach of another female lizard, SVL = 50 mm (LACM 139661). Both helminths were recovered from the California subsample (Palm Springs and Cadiz Dry Lake). *Physaloptera* sp. represents a new host record for *U. graciosus graciosus*. Both helminths were deposited in the USNM Helminthological Collection, USDA, Beltsville, Maryland 20705: *Oochoristica* sp. (82303); *Physaloptera* sp. (82302).

Discussion

Telford's (1970) report of *Oochoristica scelopori* from 2 of 34 (6%) along with the 41 specimens we examined gives a combined total of 75 specimens and a helminth prevalence of 5%. These data suggest a depauperate helminth fauna for *U. graciosus* both in number of helminth species and in intensity of infection.

Of the sixteen species of nematodes, four species of cestodes and one species of acanthocephalan recovered from Riverside County, California lizards (Table 1), only one species of nematode and one species of cestode are known from *U. graciosus graciosus*. The lack of shared helminth faunas with sympatric lizards may be due to habitat and resource partitioning. According to Pianka (1973), lizards may partition three major resources: habitat, food, and time. *Urosaurus graciosus graciosus* is primarily arboreal and forages in the open canopy of small desert trees for arboreal insects (Vitt et al. 1981). The other lizards are ground dwellers (Stebbins 1985). Arboreal and ground-dwelling lizards feed on different prey which may help explain differences in parasite loads. Also, arboreal lizards may be able to avoid contaminated soil better than ground-dwellers.

The life cycles of species of both *Oochoristica* and *Physaloptera* have not been well studied. To date, all studies of *Oochoristica* life cycles (Millemann and Read 1953; Hickman 1963; Widmer and Olsen 1967; Conn 1985) and *Physaloptera* life cycles (Hobmaier 1941; Petri 1950; Petri and Ameel 1950; Schell 1952; Lincoln and Anderson 1975) indicate an insect intermediate host.

Third stage *Physaloptera* sp., but not adults, have been recovered from a variety of amphibians and lizards (Table 2). It should be noted that adults of species of *Physaloptera* are unknown from the Amphibia. Since insects serve as intermediate hosts to *Physaloptera* spp. as well as *Oochoristica* spp., diet may be the primary factor producing differential infection rates. However, Table 2 suggests that other factors are also important as *Physaloptera* fails to reach adult stages in at least 36 species of herptiles. Prevalence is variable among these species (Table 2), perhaps related to the proportion of insects in the diets, and thus potential infection. However, sufficient infection by third stage larvae of *Physaloptera* has been documented (note especially *Cnemidophorus* spp., Table 2) to suggest that some internal mechanism, perhaps some aspect of the physiology of these amphibians and reptiles, prevents survival of *Physaloptera* to the adult stage. The absence of *Oochoristica* sp. in some lizards suggests that similar physiological factors are operating here also. Much work remains to be done before the life history requirements of *Oochoristica* and *Physaloptera* are understood and why some herptiles serve as hosts while others present an unfavorable environment for parasites.

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Appendix 1

Boulder City, Clark County, Nevada (LACM, Natural History Museum of Los Angeles County, LACM 19022, 19030, 19043, 19044, 19046, 19048, 19055, 19061, 19063–19065, 19067, 19072, 19074, 19075, 19079, 19080–19082, 19085); Thousand Palms, Riverside County, California (LACM 139658, 139659); Palm Springs, Riverside County, California (LACM 139643–139657); Cadiz Dry Lake, San Bernadino County, California (LACM 139660–139662); Blythe, San Bernadino County, California (LACM 139663).